NUEXCO

JULY 1984 NUMBER 191

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

July 1984 No. 191

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NATURAL URANIUM AND CONVERSION

The **Exchange Value** as of June 30, 1984 is **$17.50** per pound U_3O_8, down $0.25 since last month. The *Current Market Data* section of this Report lists four uranium sales transactions, involving a total of approximately 5.8 million pounds U_3O_8 *equivalent*. Two of those transactions were sales of concentrates and two involved natural UF_6.

Active supply of uranium (U_3O_8 and UF_6) for spot and near-term delivery totals **4.3 million** pounds U_3O_8 or equivalent UF_6, down 900 thousand pounds since last month. The corresponding figure for **active demand** is **1.9 million** pounds, down 500 thousand pounds. The spot and near-term **supply-demand ratio** remained **2.2:1.**

The **Transaction Value** as of June 30, 1984 is **$16.50** per pound U_3O_8, down $0.50 since last month primarily due to the addition of one large UF_6 transaction at a price well below the current Exchange Value. The current Transaction Value includes 18 transactions involving a total of 5.4 million pounds U_3O_8 or equivalent UF_6 and covers a period of 4 months.

The **Loan Use Charge Rate** as of June 30, 1984 is **6 percent** per annum, unchanged since last month. No uranium loans are reported.

* * *

The Exchange Value fell $0.25 during June after sellers' offers near the previous month's level failed to elicit firm buyer responses. While some sellers are offering at prices above $17.50, there is a significant quantity of material available at or below that level. The near-term demand for uranium has decreased steadily over the past few months. Approximately half of the current demand comes from utilities in little hurry to make purchasing decisions. The other half of demand is comprised primarily of discretionary buyers interested only in bargain prices. A significant spread exists between most sellers' offering prices and the interest level of the discretionary buyers that dominate the market.

* * *

The **Conversion Value** is **$0.00** (zero) per pound U in UF_6 as of June 30, due to the continued absence of demand for conversion services and the ability of holders of concentrates to swap for natural UF_6 at no cost. The most active natural UF_6 sellers have been willing to swap their UF_6 for U_3O_8 at no cost in order to meet certain uranium buyers' preferences for U_3O_8. Although similar market conditions have existed for several months, Nuexco had refrained from dropping the Conversion Value to zero in the past because some potential buyers had expressed a willingness to pay some small amounts for conversion. However, for the past three months there has been no active demand for secondary market conversion services, and, as of June 30, Nuexco knew of no buyers willing to consider paying anything for secondary market conversion services.

No secondary market conversion transactions are reported this month. The *Pricing* section of last month's Report (Number 190) made reference to a conversion transaction in which a "primary supplier had in effect competed with secondary market prices." The transaction involved less than 100 thousand pounds U in UF_6, and contrary to the implication of the referenced article, the price involved was *not* directly competitive with current secondary market prices. Furthermore, the transaction was *not arm's length*, and for that reason (as well as the fact that it was a primary, not a secondary, market sale) was not included on the transaction page of the same Report.

SECONDARY MARKET ENRICHMENT SERVICES

The **SWU Values** as of June 30, 1984 are **$95** for **DOE origin** and **FY85 delivery,** down $10, and **$80** for **non-DOE origin** and delivery within approximately 15 months (unchanged). No secondary market SWU sales are reported. Active secondary market supply of enrichment services totals approximately 405 thousand SWUs, down sharply since last month, while active demand amounts to 175 thousand SWUs, also sharply down.

Several buyers previously considered active have withdrawn from the market temporarily in order to reassess the developing SWU market. Thus, they are listed as inactive in the SWU demand table of the *Current Market Data* section of this Report. Much of the inactive SWU demand is comprised of probable USEC signers that have not made final decisions regarding the contract. Near-term SWU supply has been falling steadily during the past few months, but recent offers have been below the levels of previous months, mainly because the few active sellers are competing for limited active demand. Nuexco is aware of numerous potential SWU sellers that will enter the market if and when near-term SWU demand rises substantially because of firm decisions to convert to the USEC. (Table 1 presents a summary of responses to the USEC to date.)

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PRICING

One of the reasons some potential SWU buyers may be hesitating to participate in the near-term SWU market is the possibility that DOE will offer additional price concessions related to the USEC. For example, the director of DOE's enrichment operations reportedly backs the idea of DOE selling SWUs for a portion of requirements at the "marginal cost of production" (which may be less than $80). As most utilities are under no time pressure regarding their enrichment decisions, they are willing to wait until DOE has offered final pricing terms.

Table 1

REGIONAL STATUS OF CONVERSION TO USEC
(Expressed in GWe of Generating Capacity)

Current Status	Former Status: Requirements Contracts 3.5-year	Former Status: Requirements Contracts 5-year	Former Status: Fixed-Commitment Contracts
USA			
Signed	—	10.3	8.3
Indicated Intent to Sign[1]	22.6	19.3	27.0
No Indication	8.2	3.5	11.2
Indicated Will Not Sign	0.5	—	—
Europe			
Signed	—	—	—
Indicated Intent to Sign[1]	—	—	—
No Indication	6.8	1.2	19.8
Indicated Will Not Sign	1.0	0.4	—
Japan			
Signed	—	—	—
Indicated Intent to Sign[1]	—	—	1.1
No Indication	3.6	5.6	13.8
Indicated Will Not Sign	—	—	—
Other			
Signed	—	—	—
Indicated Intent to Sign[1]	—	—	8.5
No Indication	—	—	0.6
Indicated Will Not Sign	—	—	—

[1]Category is not limited to letters of intent that DOE has received, but also includes other indications of intent to convert.

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CURRENT MARKET DATA

June 30, 1984	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$17.50**/ lb. U_3O_8	4,305	1,945
CONVERSION VALUE	**$0.00**/ lb. U in UF_6	2,825	0
SWU VALUES			
DOE origin, FY85 delivery	**$95**/ SWU	405	175
non-DOE origin, delivery within 15 months	**$80**/ SWU		
LOAN USE CHARGE RATE	**6%**/ annum	7,050	500

TRANSACTION VALUE	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
	16.50	5.4	18	4

[1]Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category. Quantities of SWUs (Separative Work Units) are not referenced to a particular origin.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at the DOE Reference Transaction Tails Assay (presently 0.20 weight-percent U_{235}) and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to Nuexco's Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (June 30, 1984)	Last Month (May 31, 1984)	12 Months Ago (June 30, 1983)	This Month (June 30, 1984)	Last Month (May 30, 1984)	12 Months Ago (June 30, 1983)
Australia (dollar)	20.21	19.74	26.83	52.55	51.33	69.76
Belgium (comm. franc)	992.06	986.66	1,194	2,579	2,565	3,104
Canada (dollar)	23.03	22.97	28.86	59.87	59.72	75.02
Finland (markka)	103.24	102.84	130.34	268.41	267.36	338.85
France (franc)	149.57	148.91	179.54	388.86	387.13	466.76
FRG (mark)	48.71	48.51	59.81	126.62	126.12	155.50
Italy (lira)	30,027	29,963	35,445	78,065	77,897	92,149
Japan (yen)	4,152	4,107	5,635	10,794	10,677	14,651
Netherlands (guilder)	54.88	54.72	67.05	142.67	142.25	174.31
South Africa (rand)	23.68	22.73	25.67	61.56	59.09	66.73
Spain (peseta)	2,766	2,726	3,406	7,191	7,087	8,854
Sweden (krona)	143.09	143.49	179.66	372.00	373.05	467.09
Switzerland (franc)	40.75	40.12	49.45	105.93	104.31	128.57
UK (pound)	12.94	12.81	15.38	33.65	33.29	40.00
US (dollar)	17.50	17.75	23.50	45.50	46.15	61.09

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (June 30, 1984)	Last Month (May 31, 1984)	12 Months Ago (June 30, 1983)	This Month (June 30, 1984)	Last Month (May 31, 1984)	12 Months Ago (June 30, 1983)
Australia (dollar)	19.06	18.91	25.63	49.55	49.16	66.64
Belgium (comm. franc)	935.37	944.97	1,141	2,432	2,457	2,966
Canada (dollar)	21.71	22.00	27.57	56.45	57.20	71.67
Finland (markka)	97.35	98.49	124.51	253.08	256.06	323.71
France (franc)	141.03	142.62	171.52	366.64	370.77	445.91
FRG (mark)	45.92	46.46	57.14	119.39	120.79	148.55
Italy (lira)	28,312	28,697	33,861	73,604	74,605	88,032
Japan (yen)	3,915	3,933	5,384	10,177	10,226	13,996
Netherlands (guilder)	51.74	52.40	64.05	134.51	136.24	166.52
South Africa (rand)	22.33	21.77	24.52	58.05	56.59	63.75
Spain (peseta)	2,608	2,611	3,254	6,780	6,788	8,459
Sweden (krona)	134.91	137.43	171.64	350.75	357.29	446.22
Switzerland (franc)	38.42	38.43	47.24	99.88	99.90	122.82
UK (pound)	12.20	12.27	14.70	31.73	31.89	38.21
US (dollar)	16.50	17.00	22.45	42.90	44.20	58.37

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on June 29, 1984.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6			per kg. U as UF_6		
	This Month (June 30, 1984)	Last Month (May 31, 1984)	12 Months Ago (June 30, 1983)	This Month (June 30, 1984)	Last Month (May 31, 1984)	12 Months Ago (June 30, 1983)
Australia (dollar)	0.00	0.89	1.37	0.00	1.96	3.02
Belgium (comm. franc)	0.00	44.47	60.98	0.00	98.04	134.43
Canada (dollar)	0.00	1.04	1.47	0.00	2.28	3.25
Finland (markka)	0.00	4.64	6.66	0.00	10.22	14.67
France (franc)	0.00	6.71	9.17	0.00	14.80	20.21
FRG (mark)	0.00	2.19	3.05	0.00	4.82	6.73
Italy (lira)	0.00	1,350	1,810	0.00	2,977	3,990
Japan (yen)	0.00	185.10	287.77	0.00	408.07	634.42
Netherlands (guilder)	0.00	2.47	3.42	0.00	5.44	7.55
South Africa (rand)	0.00	1.02	1.31	0.00	2.26	2.89
Spain (peseta)	0.00	122.87	173.91	0.00	270.88	383.41
Sweden (krona)	0.00	6.47	9.17	0.00	14.26	20.23
Switzerland (franc)	0.00	1.81	2.53	0.00	3.99	5.57
UK (pound)	0.00	0.58	0.79	0.00	1.27	1.73
US (dollar)	0.00	0.80	1.20	0.00	1.76	2.65

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (June 30, 1984)	DOE SWU FY85 (May 31, 1984)	Non-DOE SWU delivery within 15 months (June 30, 1984)	Non-DOE SWU delivery within 15 months (May 31, 1984)
Australia (dollar)	109.74	116.80	92.41	88.99
Belgium (comm. franc)	5,385	5,837	4,535	4,447
Canada (dollar)	125.02	135.89	105.28	103.53
Finland (markka)	560.47	608.34	471.98	463.50
France (franc)	811.97	880.87	683.76	671.14
FRG (mark)	264.40	286.96	222.66	218.64
Italy (lira)	163,006	177,245	137,268	135,044
Japan (yen)	22,539	24,294	18,980	18,510
Netherlands (guilder)	297.90	323.67	250.86	246.61
South Africa (rand)	128.55	134.44	108.25	102.43
Spain (peseta)	15,015	16,127	12,644	12,287
Sweden (krona)	776.78	848.83	654.13	646.73
Switzerland (franc)	221.19	237.34	186.26	180.83
UK (pound)	70.27	75.76	59.17	57.72
US (dollar)	95.00	105.00	80.00	80.00

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on June 29, 1984.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3042A	1984	1,501-3,000	89	European Entity	US Utility	UF_6. Inventory purchase.
3042B	1990-97	1,501-3,000	indeterminate	European Entity	US Utility	
3004	1985	101-300	97	unknown	European Utility	UF_6. Seller probably a broker.
2997	1984	101-300	96-102	Canadian Producer	US Utility	
2993	1988-94	1,501-3,000	indeterminate	European Broker	US Utility	Seller-financed. Buy-sellback. Escalated base price.

[1]Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.

Note: No secondary market transactions for enrichment services or conversion services are reported this month.

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URANIUM SUPPLY
(As of 6/30/84)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	—	500 per year	
1818	—	500 per year	1985-90
2134	220	—	
2201	95	—	
2236	—	200 per year	1985-89
2263	—	500 per year	1985-90
2275	145	—	
2288*	—	100	1985
2297	—	200 per year	1985-89
2336	—	250 per year	
2368	—	2,800	
2389	300	—	
2390	100	—	
2392	35	—	UF_6
2436A	850	—	enriched UF_6
2484	130	—	
2489	—	500	1986-90
2505	280	—	U_3O_8 or UF_6
2509	1,200	1,600	UF_6
2521*	50	100	U_3O_8 or UF_6
2557*	500	—	UF_6
2565	400	—	
TOTAL:	4,305		
INACTIVE			
0564	—	1,000 per year	1985-90
2191	125	—	UF_6
2193	—	800 per year	1986-90
2271	—	500 per year	1984-88
2326	—	3,500	1988-91
2429	450	—	
2473	—	500 per year	1984-90
2495*	130	—	UF_6
2514	—	1,000 per year	
2553	300	—	
TOTAL:	1,005		

*New or revised since last month.

[1]Measured from the date of this Report.

[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2376, 2365, 2335, 2038, 2017.

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CURRENT MARKET DATA

URANIUM DEMAND
(As of 6/30/84)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2217	—	1,000 per year	1988-95
2329	—	500	1985
2352	240	—	
2355A	—	1,400	enriched UF_6
2419	60	—	UF_6
2456	650	—	UF_6
2494*	200	250	1985
2506*	60	—	U_3O_8 or UF_6
2558	235	—	UF_6
2566	500	—	
TOTAL:	1,945		
INACTIVE			
1999	—	50 per year	1985-90
2244	—	350 per year	
2372	—	250 per year	1985-88
2413	—	250 per year	1986-88
2414	—	150 per year	1987-91
2442*	—	250 per year	1986 on
2457	—	550	1987
2507*	—	300	1987-88
2528*	—	250 per year	1991 on
2542A	1,400	—	enriched UF_6
TOTAL:	1,400		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2463, 2445.

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LOAN SUPPLY AND DEMAND
(As of 6/30/84)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
ACTIVE			
1938	2,000	—	UF_6
2128	2,500	—	
2139	2,000	—	
2483	550	—	
TOTAL:	7,050		
Inquiries to Borrow:			
ACTIVE			
2453	500	—	
TOTAL:	500		

Projects removed since last month: 2493.

CONVERSION SUPPLY AND DEMAND
(As of 6/30/84)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2141	2,600	—	
2511*	225	—	
TOTAL:	2,825		
INACTIVE			
2051*	1,000	—	
2401	600	—	
2438	220	220	1985-87
2511*	330	330	1986-90
TOTAL:	2,150		
Inquiries to Purchase:			
INACTIVE			
2420	300	—	1986
TOTAL:	300		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: 1936.

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CURRENT MARKET DATA

SWU SUPPLY
(As of 6/30/84)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	—	100 per year	1986-87
2285	—	1,500	
2351	—	250	1986-88
2408	100	60	1986
2428	80	—	
2436B	225	—	enriched UF_6
2469	—	80	1987
TOTAL:	405		
INACTIVE			
2192*	—	210	1986-87
2345*	150	—	
TOTAL:	150		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2510, 2378.

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SWU DEMAND
(As of 6/30/84)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2237	—	400 per year	1987-88
2355B	—	600	enriched UF_6
2432A	50	—	
2452	30	—	1985
2503	—	330	1986
2519	—	30 per year	1987 on
2522	20	—	
2544*	45	—	
2546*	30	—	
TOTAL:	175		
INACTIVE			
2407	75	130	1986
2432B	—	30 per year	1987 on
2443*	150	—	
2449	50	—	
2454*	75	75	1986
2459	50	50 per year	
2471	60	40 per year	
2479*	—	50	1986
2512	—	15 per year	1987 on
2518*	—	160	1987
2542B	340	—	enriched UF_6
2543	—	25 per year	1987 on
2550*	50	—	
2552*	35	—	
2567	—	45 per year	1987 on
TOTAL:	885		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2520, 2475, 2448, 2412, 2400.

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COMMENTARY

DOE, ENRICHMENT POLICY, AND THE NATIONAL INTEREST

by **J.R. Wolcott,** *Chairman, Nuexco*

The US Department of Energy's (DOE) enrichment program has encountered numerous problems over the past few years. Setbacks to nuclear power growth have cut the requirements for enrichment services in half. Non-US customers have canceled many of their DOE contracts and chosen to purchase SWUs elsewhere in the world market. An active secondary market has reduced the near-term demand for primary services and heightened price competition. Declining revenues have threatened to make DOE's statutory requirement of full-cost recovery very hard to meet. DOE has come under fire from parts of Congress for alleged mismanagement.

DOE has endeavored to put a stop to these problems with a new contract that provides flexible terms and lower prices than DOE charged previously. It hopes that enough utilities will sign the contract to keep production volume high and maintain DOE's majority share of the world market (currently around 60 percent). It also hopes that revenues from those contracts, when combined with changes in certain accounting practices and the introduction of new technology, will keep its current program structure intact.

Need for Customer Concern

DOE's strategy should be considered closely by utility customers. DOE and its customers have a unique contractual relationship. Decisions on SWU prices, program costs, technology, and market strategy are made by DOE, approved by Congress, and passed on to customers. However, the Atomic Energy Act requires that all of the consequences of DOE's decisions be paid for in full by the customers. Payment may be delayed, because full-cost recovery is required only over a "reasonable period of time."

According to the US government's General Accounting Office (GAO), which reviewed DOE's current enrichment program for a Congressional committee, DOE could lose more than $3 billion over the next ten years. DOE disputes this assertion. Whether DOE or GAO is correct may not be known for some time, but the question should not be ignored. Legal compliance and individual accountability are involved. If GAO is right, a "cost bulge" is being pushed forward that DOE's customers must eventually swallow. Congress could eliminate it in some other way, but the national debt, the reluctance of Congress to subsidize nuclear power, and the trend towards increasing government revenues make that possibility doubtful.

Nationalism and Competition

The US government had a world monopoly on commercial enrichment supply 15 years ago. At the time, the government believed it had an obligation to make those services available to other nations. It also came to believe that it could use its monopoly for political ends, such as to control the production and use of enriched uranium generally. That worked for a while. However, the tendency of all nations to promote self-sufficiency in energy was a natural force against the continuance of the US government's monopoly. When the Atomic Energy Commission, DOE's predecessor, "closed the order books" in the early 1970s because of a perceived shortage of future production capacity, other nations were forced to look elsewhere for supply. The Urenco group formed in 1971, Eurodif formed in 1973, and European utilities began signing contracts with the USSR about the same time.

The US monopoly on enrichment supply was bound to be challenged. Today the market is highly competitive, and oversupply, rather than limited supply, is the problem. US government notions of establishing a DOE monopoly to control the supply of enriched uranium are not even faintly realistic. No competitive supplier even bothers to suggest such a motive for its own aggressiveness. The nationalism of most countries with regard to energy autonomy strongly suggests that the non-US market for DOE SWUs will continue to diminish.

DOE's Fading Export Market

The European market for enrichment services is not homogeneous, but most countries do lean strongly toward independence. Electricite de France, having the largest nuclear program on the continent, is probably the most nationalistic of DOE's potential European customers. Purchases will not be made from DOE mainly because the Eurodif plant is located in France, and the French national fuel cycle company Cogema is the principal shareholder in Eurodif. Eurodif prices are more favorable than DOE prices in any case. All of the other countries participating in Eurodif—Italy, Spain, and Belgium—also have a vested interest in its production and are thus unlikely to buy SWUs from DOE.

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The Federal Republic of Germany, Holland, and the United Kingdom all have Urenco production facilities within their borders, and majority ownership of each of those facilities is controlled by the national government or national industrial concerns. Close alliance exists between Urenco and the nuclear power industries in the three countries. Although there are several German utilities, few of which have vested interests in Urenco, the market for DOE is not favorable. Sweden and Switzerland, which together constitute about 5 percent of the world enrichment market, are participants in neither Urenco nor Eurodif. Both are neutral in their procurement practices; thus, if DOE's price is above the competition, the Swedish and Swiss utilities are unlikely to buy from DOE.

Europe is obviously a declining market for DOE. The growth of strongly competitive energy companies in nationalistic markets makes it difficult for outside entities to penetrate those markets, or hold their positions. In DOE's case, to capture and hold the European market would require pricing at ridiculously unprofitable levels.

The market in Japan, traditionally a DOE monopoly, is gradually changing. A few years ago the utilities began to diversify by contracting with Eurodif for a portion of their needs. Recently, a government-sponsored program for the development of commercial centrifuge enrichment capacity has led to construction on a demonstration plant capable of producing 200,000 SWUs per year. A utility-owned company will be formed to sponsor a larger commercial plant, and a preliminary site for that plant has recently been selected. The national goal is to produce at least one-third of Japan's enrichment needs by the year 2000.

Japan has an established history for industrial self-development. The process involves buying products from foreigners at the outset, developing domestic technology (often by purchase of technical licenses), establishing production capability, gradually building domestic production, and finally supplying all domestic needs. In the nuclear industry alone that has been the pattern for turbine-generators, steam supply systems, fuel fabrication plants, etc.

DOE will continue to be the largest supplier in the Japanese market for the short term. In the long term, however, DOE's prospects are not promising. Having limited indigenous resources, Japan seeks self-sufficiency. Its centrifuge process is similar to that used by Urenco. Once commercial production is demonstrated, there is little reason to believe that Japanese utilities will not expand to fill any needs not already covered by prior contracts. It would be a mistake for the USA to invest resources on the assumption that they would be used to supply a long-term Japanese market.

Other countries with nuclear power programs that are potential customers of DOE include Korea, Taiwan, South Africa, Brazil, and Argentina. Some of those potential customers have indicated plans to develop enrichment self-sufficiency in the long term, but most will buy competitively. The competitive market available to DOE is not large enough to have a major effect on policy.

DOE's Service Base: The US Market

The US market is biased towards DOE supply as other nations' utilities favor their domestic suppliers. But nations such as France, the UK, and Italy have only one nuclear utility, whereas the United States has approximately 60. Roughly half the US utilities insist upon domestic SWU supply; the remaining half need economic incentives to offset widely varying degrees of bias in favor of domestic supply.

DOE will probably retain 70 to 80 percent of the US market under any conditions. The remaining 20 to 30 percent will seek the most competitive supply terms, but there is ample reason to anticipate that DOE will remain the dominant long-term US supplier.

Enriched uranium inventories have accumulated over the past decade as a result of rigid supply contracts and drastic cutbacks to US utility nuclear power programs. An active secondary market has resulted and is probably at its peak. It will begin to ease as surpluses decline. A subsiding secondary market should be evident within 6 to 12 months.

Defining DOE's Purpose

From a business point of view, it is often difficult to understand government policies such as DOE's. Political, social and institutional considerations merge and intertwine and in doing so confuse what is *desirable* with what is *practical and economical.* Approval of DOE's policies rests with Congress. However, unlike business, in which the policies of management are subject to review and management bears the burden of proving the economic strength of those policies, Congress bears the burden of proving fault with DOE's policies.

An adversary relationship exists between DOE and some Congressional bodies. DOE usually presents a po-

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sition and provides minimal justification or explanation. Congress may be aided by the General Accounting Office (GAO) in its review. However, there are a multitude of Congressional Committees having overlapping responsibilities, and they do not function as a single body. Each has its own views and political interests. Antagonisms, empathy, cooperativeness, etc., vary from committee to committee and among legislators. The normal practice for a bureau such as DOE is to court the committee with the most influence over budget. In any case, the system does not operate like a business, simply because political and institutional solutions, which are the focus of government, override economic solutions, which are the focus of business.

Because of the many peculiarities of government, it is not always easy to determine what a policy is or even whether one exists. What is the purpose of the US government's enrichment program? Should DOE act as a national service (like the postal service)? A commercial business (like Urenco)? A political instrument (like a branch of the State Department)? A monopoly (as it once was)? All of these forms cannot be pursued simultaneously without conflicts and inconsistencies. For example, DOE will not achieve a satisfactory return on its investment if it cuts prices in an effort to regain a monopoly or enhance its control over nuclear proliferation.

DOE's only *practical* role in the existing market framework is that of an efficient national service. Such a role obligates DOE only to meet US needs and non-US contract obligations as they exist or are accepted. It does not obligate DOE to compete to maximize world market share, or to serve State Department ends. It does not obligate DOE to contradict itself by pressing for a monopoly on the US market in order to "preserve US energy independence"—while at the same time attempting to keep Japan or Taiwan dependent upon the USA. It does not obligate DOE to invest funds in facilities to supply services to non-US utilities.

If DOE's role is clarified, each of its programs can be judged by specific criteria, much as a business evaluates courses with respect to profitability. A clear definition of mission would enable Congress and the Executive Branch to work from a common starting point.

Policy Choices

In fulfilling its role DOE faces two key policy choices:

1. Whether to follow an *offensive* or a *defensive* marketing strategy;
2. Whether to be a price *follower* or a price *leader*.

In addition, it must determine the appropriate role of research and development and the degree to which its current operations need fundamental restructuring.

Any business in crisis, as DOE views itself, has to choose between an offensive and a defensive strategy. An offensive strategy may be defined as one in which DOE attempts to enlarge its market share, obtain new non-US contracts, and sustain a near-monopoly position in the USA. A defensive strategy may be defined as one in which DOE reduces its size and ambition to the lowest limit possible that still serves the national interest, and then allows economics alone to determine expansion and investment.

Normally price stability in a concentrated industry such as the enrichment market is achieved when one participant is recognized as the price leader and others adjust their prices accordingly. The price leader is usually the least vulnerable. When the leader is also the highest-cost producer, as DOE is, the followers profit by settling for a reasonable market share under the leader's umbrella. The strength of the price leader is the security of its market base and its lack of desperation.

If DOE followed a defensive strategy, it would formulate policies according to national interest rather than the actions of the competition, and it would remain a price leader. Eurodif, Urenco and the USSR would follow DOE's lead, as they have in the past, or they would compete among themselves. If DOE chooses to be a price follower by attempting to match low prices offered by other enrichers, chaos will result. At the moment DOE appears much more concerned with "price followership" than "price leadership."

New Technology Is Not Necessarily a Solution

DOE is the world's highest cost and highest volume enrichment producer, and it has the largest available production capacity—followed by Eurodif, the USSR and Urenco. Presently Urenco is the only enricher employing centrifuge technology for commercial purposes. DOE's planned centrifuge program (GCEP) is much grander than the Urenco program—based largely, perhaps, on the old philosophy that big is beautiful.

Currently a large portion of the DOE enrichment program budget is marked for the development of new technologies. The main reason is that DOE expects new technology to give it a competitive cost advantage, that the cost advantage will lead to a price advantage, and that the price advantage will lead to market gains. Even if the goal of gaining market share were desirable in terms of the US national interest, it is not clear that competitive conditions support the reasoning. Both Eurodif and the

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USSR use the gaseous diffusion process employed by DOE, and both have substantially lower volumes, ranging from one-third to one-tenth that of DOE. Both nevertheless price their services well below DOE and claim that low costs would enable them to match any DOE price. A change in technology may not resolve DOE's problems.

This does not suggest that research and development is not worthwhile. It does suggest that factors other than technology play an important, perhaps decisive, cost and pricing role. DOE's cost problems may be structurally embedded such that they will not be solved by changing technology or by increasing volume. A new technology employed in the same political and institutional framework may leave DOE in about the same position. Similarly, an institutional restructuring might place DOE in a competitive position using the 27 million SWUs of existing gaseous diffusion capacity, and thus allow for more relaxed GCEP and AVLIS schedules. Answers to questions about the institutional structure and costs of DOE should be sought to find out if DOE is attempting to solve institutional or political problems with a technological solution.

Comparative Cost Structures

DOE operates three gaseous diffusion plants in three locations. By far the largest element of cost for all three is power. Approximately two-thirds is supplied by the Tennessee Valley Authority (TVA), with the balance by private utilities. For various contractual reasons, TVA's power charges are approximately two times those of private companies. During the forthcoming year, DOE will pay approximately $100 per SWU for power costs alone, though it will charge its customers only $67 per SUW for power. The lesser figure is derived by using low-cost SWU taken from inventory. During 1984 approximately 15 million SWUs will be delivered, but only 10–12 million will be produced.

The GCEP plant, if completed as proposed, will cost $6.5 to $7.5 billion and will have the capacity to produce approximately 13 million SWUs per year. While the power requirement will be on the order of 10 percent that for diffusion, high fixed charges will have to be borne regardless of volume.

SWU production has to be viewed comprehensively as a combined system in which power plays a major part. Gaseous diffusion provides one economic structure; centrifuge technology another. An important difference exists between fixed and variable charges. A high fixed-charge system, such as GCEP, needs firm, fixed loading to be economical. A high variable-cost system can accommodate changing markets. Furthermore, in a choice between investing in a general-purpose facility (such as the power generation plants required to service the gaseous diffusion technology) or a special-purpose facility (such as the centrifuge machines for GCEP), a sound business approach would favor the former.

Eurodif has taken the former approach. Several billion dollars were invested in four nuclear power units to supply cheap power to the diffusion plant. The effect of this was to place investment on the power generation side, rather than on the separation plant side, resulting in two advantages.

1. The heavy investment is multi-purpose. When SWU production does not require use of facilities, electrical energy can be sold to the French grid. The combined separation plant and nuclear plant system constitutes a high variable-cost, low fixed-cost system.

2. Investment can be depreciated over a longer term (perhaps 30 years) because new technologies do not threaten to make the nuclear power obsolete. A GCEP plant investment, on the other hand, is vulnerable to technology advances, such as laser technology. A 10-year depreciation period may be realistic.

The form of enrichment system comparison described above is only one of several that exist. The example illustrates that employing the most "advanced" technology may not be a practical solution to structural problems.

Conclusions

DOE should not be optimistic about gaining or even maintaining its share of the non-US enrichment market. Instead, it should redefine its role in the enrichment market to serve the US national interest. Specifically:

1. It should pursue a defensive, rather than an offensive, strategy;

2. It should concentrate on serving the US market as a government service;

3. It should restructure competitively using the present technology. A clearer understanding is needed of the costs and benefits associated with new technologies.

DOE's course of action should be of increasing concern to utilities. If, as GAO predicts, aggressive pricing, technological development and facility investment policies do not produce the results DOE hopes for, US utilities eventually may be required to pay the bill.

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URENCO

Introduction

The governments of the United Kingdom, the Federal Republic of Germany, and the Netherlands created the basis for Urenco in March 1970, when representatives from each country signed an agreement at Almelo, the Netherlands, to coordinate their national centrifuge enrichment projects. Today, Urenco is the only one of four commercial uranium enrichment enterprises that uses gas centrifuge technology; the other three enrichers, Techsnabexport, Eurodif, and the US Department of Energy (DOE), operate gaseous diffusion plants. (Japan's Power Reactor and Nuclear Fuel Development Corporation (PNC) is building a centrifuge enrichment demonstration plant, but it is not scheduled to begin SWU production until 1987.)[1] Urenco is marketing its services aggressively, and has made highly competitive contract offers due to the cost advantages inherent in the centrifuge process and plant design.

Ownership Structure

Urenco can be described as a federation of centrifuge enrichment enterprises brought together to benefit from the coordination of research, investment, and sales. The marketing agent and managing company of the group is Urenco Ltd., headquartered in the UK and owned one-third each by BNFL, UCN, and Uranit (see Figure 1 for full company names). Although centrifuge research is carried on in all three countries, the principal research and development company of the group is Centec, headquartered in the FRG and owned one-third each by BNFL, UCN and GNV. BNFL owns and operates one Urenco enrichment plant at Capenhurst in midwest England, the site of the UK Atomic Energy Authority's now-retired gaseous diffusion plant. UCN and Uranit share ownership of a second, larger plant at Almelo, and Uranit is building a third facility at Gronau, FRG, just across the border from Almelo (Figure 2).

Plant Capacities

At the time Urenco was incorporated, BNFL was constructing a pilot-scale centrifuge plant at Capenhurst, and German and Dutch teams simultaneously were building two pilot plants at Almelo. The machines in those pilot plants were small and the result of largely independent design work, and thus constituted a mixed first generation for the group as a whole. The results of independent efforts were combined gradually thereafter. Urenco received its first commercial enrichment contract in 1974, and construction began in that year on two commercial demonstration plants, one at Capenhurst and one at Almelo, each having a planned annual capacity of 200,000 SWUs. Installation of the first of four halls of second-generation centrifuge machines was compieted in both plants in the Fall of 1977. Each hall (Figure 3) contained eight cascades. Both demonstration plants reached full production capacity in 1980.

Figure 4 is a recent aerial view of the Almelo plant site. Since the completion of the demonstration plants, Urenco has added plant capacity at both sites on a modular basis to meet its growing delivery commitments. The addition of 200,000 SWUs of capacity at Capenhurst, and 400,000 SWUs of capacity at Almelo began in 1980 and was completed in 1983, at which time further expansion was initiated. Urenco's total annual production capacity in 1982 approximated 900,000 SWUs, increasing to over 1 million SWUs in 1983. Construction at the 80-hectare (200-acre) Gronau site began in mid-1982; plant buildings there are now complete, and installation of a third generation of centrifuges has begun. Urenco projects a total annual production capacity of 3 million SWUs in 1990 and 4.5 million SWUs in 1995, at which time each of the three plants will have the capacity to produce 1.5 million SWUs a year.

Feed and Product Handling

The allocation among plants of SWU deliveries is managed by Urenco Ltd. Upon arrival at a plant site, natural UF_6 is weighed, sampled, and put in temporary storage. Feed is moved as needed to a station in the main process building, where it is loaded into an autoclave and connected to a feed manifold. Over a period of 24 hours, steam heats the container to 70–80 degrees Celsius. When the stop valve of the container is opened, the liquid hex vaporizes and flows from the feed manifold through the main feed distribution system of the plant.

The feed distribution main connects to individual cascades within an operational module of the plant via isolation and flow control valves. Thus, cascades can be disconnected from the system selectively. Each cascade yields product and tails streams having enrichment and depletion levels coordinated for the module. The streams feed into collective product or tails de-sublimers, which, at low pressure and a temperature of approximately -70

[1] See page 21 of Report 185 for an article on *US DOE Gaseous Diffusion Plants;* page 26 of Report 188 for an article on *Eurodif;* and page 29 of Report 189 for an article on *Uranium Enrichment in Japan.*

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degrees Celsius, cool and solidify the UF_6. When a desublimer is full, it is isolated from the module and heated; UF_6 gas is then transferred via pipelines to a central handling area. There, after weighing, analysis, and blending if necessary, enriched product is condensed into containers for shipping.

Production Commitments and Marketing

More than half of Urenco's current services are provided through BNFL to the UK's Central Electricity Generating Board (CEGB), as indicated in Table 2. Contracted deliveries to German utilities will take an increasing share of production over the next few years. Up to now, Urenco has not met with notable success in marketing its services outside of Europe, or more generally, outside of the three countries participating in the enrichment venture. Recently, however, the company has stepped up efforts to sell SWUs in the USA and the Far East. It hopes to gain sales to committed DOE customers that are able, under the terms of the USEC, to purchase 30 percent of enrichment requirements abroad.

Moreover, Urenco hopes to lure traditional customers of DOE away from the USA altogether. In competition with both primary enrichers and secondary market SWU sellers, Urenco has offered prices equivalent to around 60 percent of the $135 USEC price. There are several explanations for the company's ability and willingness to price its services at such low levels.

1. Unlike any of its competitors, Urenco has controlled investment in plant production capacity to correspond with actual delivery commitments. Existing facilities have operated at close to 90 percent of capacity, as compared with less than 60 percent for Eurodif and approximately 40 percent for DOE.

2. Centrifuge enrichment involves certain inherent cost advantages over gaseous diffusion, not the least of which is a lower power requirement. Urenco claims to expend a plant total of approximately 80 kwh per SWU at its facilities, which is less than 5 percent of the power requirement for operating gaseous diffusion plants.

3. Urenco's centrifuge machines have demonstrated a machine failure rate of less than 0.5 percent. Because the group has developed relatively small centrifuges (the third generation machines have capacities of around 50 SWUs per year), those machines that do fail do not interrupt cascade operation.

4. Undoubtedly the Urenco group is offering low SWU prices primarily to attract customers, and thus gain the opportunity to establish international credibility.

Table 2

NUEXCO ESTIMATE OF URENCO DELIVERY COMMITMENTS (Millions of SWUs)

Country	'83	'84	'85	'86	'87	'88	'89	'90
UK	0.58	0.71	0.83	0.86	0.86	0.86	0.86	0.85
FRG	0.37	0.51	0.76	0.58	1.07	1.10	1.25	1.17
Other	0.01	0.01	0.06	0.39	0.48	0.34	0.47	0.47
TOTAL	0.96	1.23	1.65	1.83	2.41	2.30	2.58	2.49

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BASIC CONSIDERATIONS

Figure 1

OWNERSHIP STRUCTURE OF URENCO GROUP

BNFL — British Nuclear Fuels Ltd. PLC
CENTEC — Gesellschaft fuer Centrifugentechnik mbH
GNV — Gesellschaft fuer Nukleare Verfahrenstechnik mbH
MAN — Maschinenfabrik Augsburg-Nuerenberg AG
PREAG — Preussenelektra AG
UCN — Ultra-Centrifuge Nederland NV
UKAEA — United Kingdom Atomic Energy Authority
URANIT — Uran-Isotopcentrennungsgesellschaft mbH

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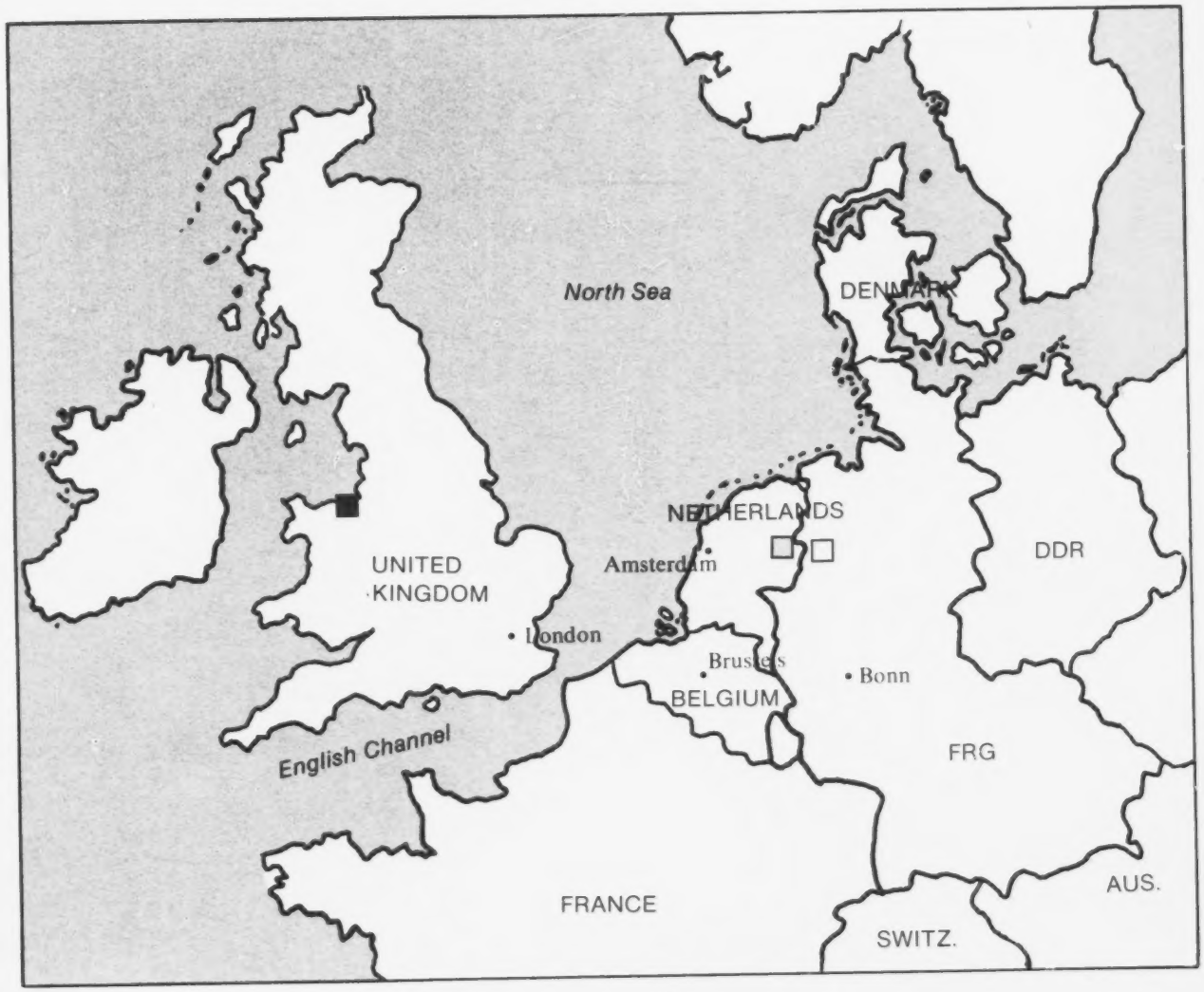
Figure 2
URENCO PLANT LOCATIONS



■ Capenhurst Plant Site (UK)

□ Almelo Plant Site (Netherlands)

□ Gronau Plant Site (FRG)

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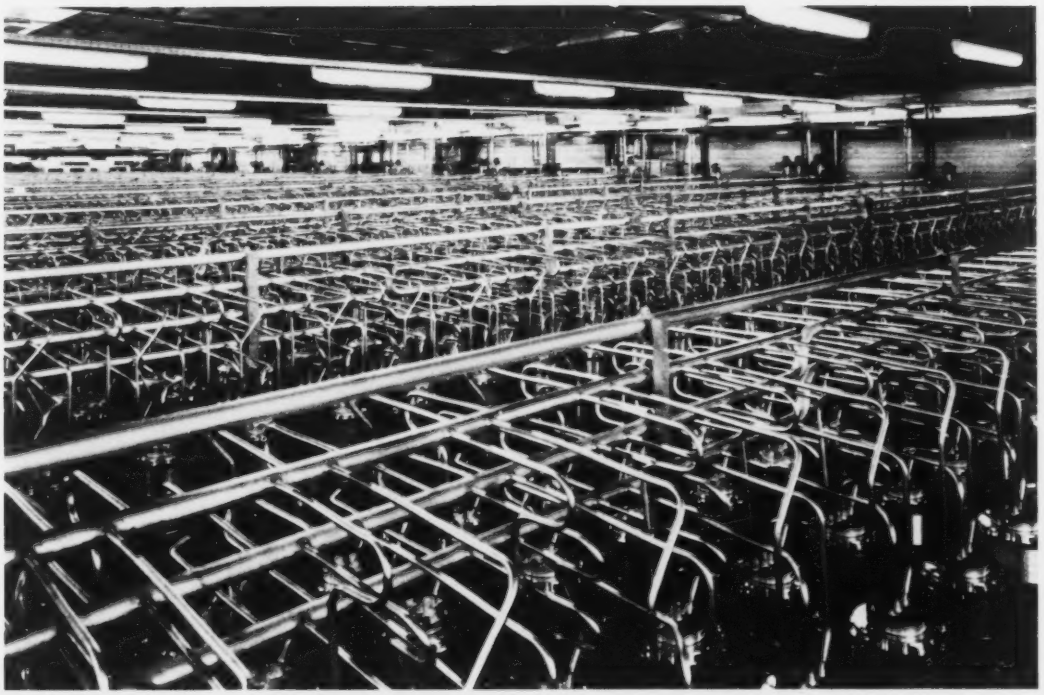

Figure 3. Centrifuge enrichment cascades.

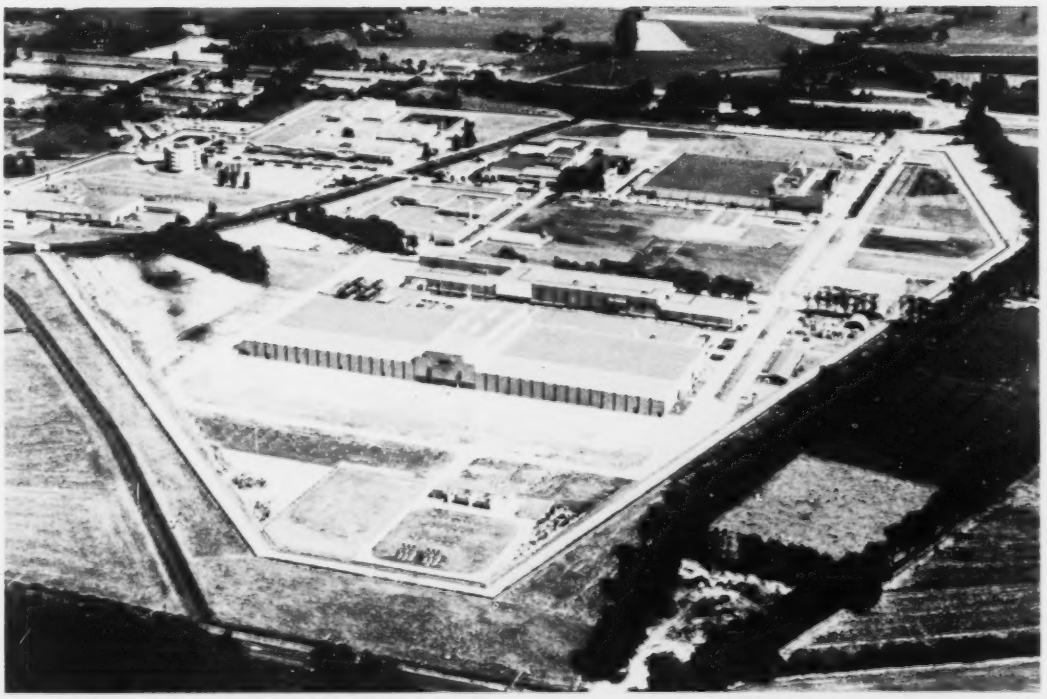

Figure 4. Aerial view of Almelo plant.

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JAPAN

Japan's Federation of Electric Power Companies (FEPC) has announced a site proposal for commercial-scale enrichment, spent-fuel storage, and reprocessing facilities. The location is in the Mutsu-Ogawara area of Aomori Prefecture, on the Shimokita Peninsula, on the northern end of Japan's main island of Honshu. An alternate proposal locates the enrichment and waste storage facilities in the Mutsu-Ogawara area, and the reprocessing facility at Higashidori, 30 kilometers to the north. Local and national governments had designated the Mutsu-Ogawara area for industrial development prior to the FEPC proposal; Higashidori was already designated a future nuclear power plant site.

The timing of the FEPC proposal was somewhat unusual. Normally announcements of preliminary nuclear-related plant sites are preceded by detailed planning and discussion with local interests. The FEPC announced its proposal prior to conducting the usual amount of preparatory work. However, the prefectural response has been favorable. Following the announcement, the prefectural governor met with national government officials to solicit cooperation in the implementation of the plan. Investment in the three facilities is likely to exceed $4 billion. Thus, the proposal promises industrial growth for a relatively underdeveloped region in Japan.

Plant siting, particularly for waste storage and reprocessing facilities, has been a major obstacle to completion of the nuclear fuel cycle in Japan. Most spent fuel is currently stored on-site, though a portion is shipped to France and the UK for reprocessing. PNC (Power Reactor and Nuclear Fuel Development Company) currently operates a demonstration reprocessing plant and is building a demonstration enrichment plant. Those plants are likely to be prototypes for the commercial facilities proposed for the Shimokita Peninsula. The utilities and related industrial concerns organized Japan Nuclear Fuel Services Company (JNFS) in 1980 to construct and operate the commercial reprocessing plant, planning for 1000 tons U per year capacity in the early 1990s. If the FEPC site proposal is approved and all three fuel cycle facilities are located in one place, JNFS may also adopt the commercial enrichment enterprise, for which an annual capacity of 1 million SWUs is hoped by 1995.

Table 3

FY 1983 GENERATING STATISTICS, JAPAN

Electric Power Company	Generating Capacity (GWe)[1]			FY83 Generation (GWh)		
	Total	Nuclear	Percent Nuclear	Total	Nuclear	Percent Nuclear
Chubu	17.39	1.38	7.9	71,880	8,586	11.9
Chugoku	7.78	0.46	5.9	25,037	2,833	11.3
Hokkaido	3.74	—	—	16,820	—	—
Hokuriku	3.61	—	—	12,171	—	—
Kansai	24.49	5.67	23.2	92,793	34,371	37.0
Kyushu	9.96	1.12	11.2	37,543	9,167	24.4
Shikoku	5.08	1.13	22.2	18,987	8,473	44.6
Tohoku[2]	8.02	—	—	35,882	597	1.7
Tokyo[3]	34.63	5.80	16.8	143,348	38,960	27.2
TOTAL[4]	114.70	15.56	13.6	454,461	102,987	22.7

[1] Installed capacity at beginning of FY 1983 (April 1, 1983). The Japan FY83 ended on March 31, 1984.
[2] Tohoku EPC's Onagawa unit 1 (524 MWe) began preliminary operations in FY83, and commercial operation is scheduled for later this year.
[3] Tokyo EPC's Fukushima unit II-2 (1100 MWe) operated during much of FY83 and began commercial operation in February 1984.
[4] Does not include Japan Atomic Power Company's 1,623 MWe of nuclear generating capacity or 10,135 GWh of nuclear-generated electricity in FY83.
Source: Japan Atomic Industrial Forum.

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RECENT DEVELOPMENTS

Table 3 presents recently released generating statistics for FY 1983 (ending March 31, 1984) for Japan's nine regional electric power companies. Nuclear power provided more than 22 percent of total megawatt hours generated by the nine utilities, while the utilities' 21 commercially operating units accounted for only 13.6 percent of total generating capacity.

Currently there are 25 units in commercial operation in Japan. Tokyo EPC's Fukushima unit II-2 began commercial operation in February of this year, and Tohoku EPC's Onagawa unit 1 is near commercial operation. While the capacities of those two units are not included in the totals presented in Table 3, power generated by them is. Japan Atomic Power Company's (JAPC) three units are not included in the analysis presented in Table 3, though electricity from those units is wholesaled to the nine electric power companies. The nine utilities supply over 80 percent of Japan's electricity needs.

Japan's 25 commercial units achieved an average capacity factor in FY83 of 71.5 percent, a record. Table 4 lists average capacity factors over the past decade. Low capacity factors in earlier years were the result primarily of technical problems encountered worldwide with BWR and PWR plant designs. Design improvements, along with reductions in maintenance and refueling down-time, have resulted in steady improvement of plant efficiency.

Table 4

HISTORICAL AVERAGE CAPACITY FACTORS, JAPAN

Year	Number of Units	Average Capacity Factor
1974	8	54.8
1975	12	42.2
1976	13	52.8
1977	14	41.8
1978	19	56.7
1979	21	54.6
1980	22	60.8
1981	23	61.7
1982	24	67.6
1983	25[1]	71.5

[1]Includes 13 BWRs, 11 PWRs, and one GCR.

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CENTRAL AFRICA

Uranium operations in Gabon and Niger produced a total of approximately 11.5 million pounds U_3O_8 in 1983, some 12 percent of total free world production. Almost all of that amount remained in the hands of the owners of the three operating production projects. The French government administered Gabon and Niger prior to their independence in August 1960; African national entities and French companies now control most of the uranium interests. Production costs are relatively high because of the combination of low average ore grade and long, variable transportation lines. Nuexco had predicted in 1983 that future output from both countries would be reduced greatly, but cutbacks for the near term have been moderate, in part because of long-term supply agreements that are not related to spot market prices.

Gabon

The Mounana mill, located approximately 50 kilometers northwest of the city of Franceville in the Upper Ogooue River region of east Gabon (Figure 5), processes all of the ore extracted from the nearby Oklo and Boyindzi deposits. Those deposits have average grades of 0.3 to 0.4 percent U_3O_8. Open-pit mining has been active at Oklo since 1970, while underground mining of a large extension began in 1977. An underground mine to exploit the Boyindzi deposit has been producing ore since December 1980. A new mill began operating at Mounana in mid-1982, having the capacity to process 440,000 tonnes ore per year. U_3O_8 output totalled approximately 2.6 million pounds in 1983, roughly 70 percent derived from Oklo and 30 percent from Boyindzi.

The owner of the project is Comuf (Compagnie des Mines d'Uranium de Franceville); it leases a 1,150 square kilometer concession area originally granted by the government of Gabon to the French CEA (Commissariat a l'Energie Atomique). The ownership of Comuf is listed in Table 5; major owners are Compagnie Francaise Mokta (39 percent), the Gabonese state (24.8) percent, Cogema (18.8 percent), and Pechiney (13.0 percent). Mokta, a subsidiary of the Imetal group, is the operator of the project. Cogema takes the majority of the output from Mounana, with other European and Japanese buyers receiving deliveries from short and medium-term contracts. Comuf receives in the neighborhood of $30–35 per pound U_3O_8 from its buyers. Comuf, Cogema, and Kepco (Korea Electric Power Company) are involved in detailed exploration programs in and around the existing concession area.

Gabon is approximately two-thirds the size of the country of France and has a population of 1.2 million. The French government recently agreed to sell the Gabonese government a small research reactor to help develop the country's educational and industrial base. A wealth of indigenous resources (primarily oil) have given Gabon the highest per capita GDP in Africa after Libya. Uranium accounts for approximately 7 percent of export earnings. A substantial portion of state revenue is currently spent on the Transgabonais railway, which will link the interior of the country to the coast. The northern half of the railway has been completed, and the link to Franceville is likely to be finished by the end of this decade. Currently it takes several days for concentrates to get from Mounana to ocean ports in Gabon or the Congo.

Table 5

OWNERSHIP OF COMUF[1]

Company	Percent Ownership
Mokta[2]	39.0
Gabon State	24.8
Cogema[3]	18.8
Pechiney	13.0
Other	4.4

[1]Comuf = Compagnie des Mines d'Uranium de Franceville.
[2]Mokta = Compagnie Francaise Mokta.
[3]Cogema = Compagnie Generale des Matieres Nucleaires.

Niger

The two projects currently producing uranium in Niger, Akouta and Arlit, are both located approximately 250 kilometers northwest of Agadez and 80 kilometers west of the Air Mountains, in central Niger (Figure 5). Akouta is ten kilometers south of Arlit; between them, and within the same concession area belonging to the CEA, is the Tassa N'Taghalgue deposit, which has been undergoing development since 1981. Niger owns shares in all of the uranium projects through the state company Onarem (Office National des Ressources Miniere).

The underground operation at Akouta began production in mid-1978. Mill output during 1983 totalled 5.2 million pounds, 58 percent of Niger's total for the year. The project owner is Cominak (Compagnie Miniere d'Akou-

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ta); its shareholders, listed in Table 6, are Cogema (34 percent), Onarem (31 percent), Japan's Overseas Uranium Resources Development Company (25 percent), and Enusa (Empresa Nacional del Uranio SA) (11.9 percent). Production distribution is reviewed annually. Output this year may be reduced by up to 30 percent due to lack of demand from Cominak's shareholders. Cogema is the operator and currently purchases approximately half of the output.

The Arlit project involves open-pit mining of three related sedimentary deposits, with ore processed in two operating mill units—one of which began production in 1971 and the other in 1980. Arlit produced 3.7 million pounds in 1983. The project owner is Somair (Societe des Mines de L'Air); its principal shareholders (Table 6) are Onarem (33 percent), Cogema (27 percent), and Mokta (19.4 percent). Cogema is the project operator. For reasons similar to those affecting Cominak, production cutbacks at Arlit of up to 40 percent have been discussed recently.

Niger is a large, predominantly desert country having a population of 5.5 million. A 400-mile road connecting the Air uranium district to Tahoua, in the more populous southern belt of the country, was first paved in the late 1970s. Uranium shipments must travel more than 2,000 kilometers from the mill to shipyards at Cotonou on the Gold Coast; at current exchange rates, transport costs add approximately $3 per pound to the price of Niger's U_3O_8 exports. Uranium accounts for some 70 percent of Niger's export earnings. Currently Onarem is waiving its option to purchase U_3O_8 from Cominak and Somair because of a lack of demand in the world market. In the past, the state company has sought uranium trade arrangements with developing Islamic nations, including Pakistan, Libya and Egypt.

Table 6

OWNERSHIP OF COMINAK[1] AND SOMAIR[2]

Company		Percent Ownership
Cominak		
	Cogema[3]	34.0
	Onarem[4]	31.0
	OURD[5]	25.0
	Enusa[6]	10.0
Somair		
	Onarem	33.0
	Cogema	27.0
	Mokta[7]	19.4
	Pechiney	7.6
	Urangesellschaft GmbH	6.5
	Agip Uranio	6.5

[1]Cominak = Compagnie Miniere d'Akouta.
[2]Somair = Societe des Mines de L'Air.
[3]Cogema = Compagnie Generale des Matieres Nucleaires.
[4]Onarem = Office National des Ressources Miniere.
[5]OURD = Overseas Uranium Resources Development Co. (Japan).
[6]Enusa = Empresa Nacional del Uranio SA (Spain).
[7]Mokta = Compagnie Francaise Mokta.

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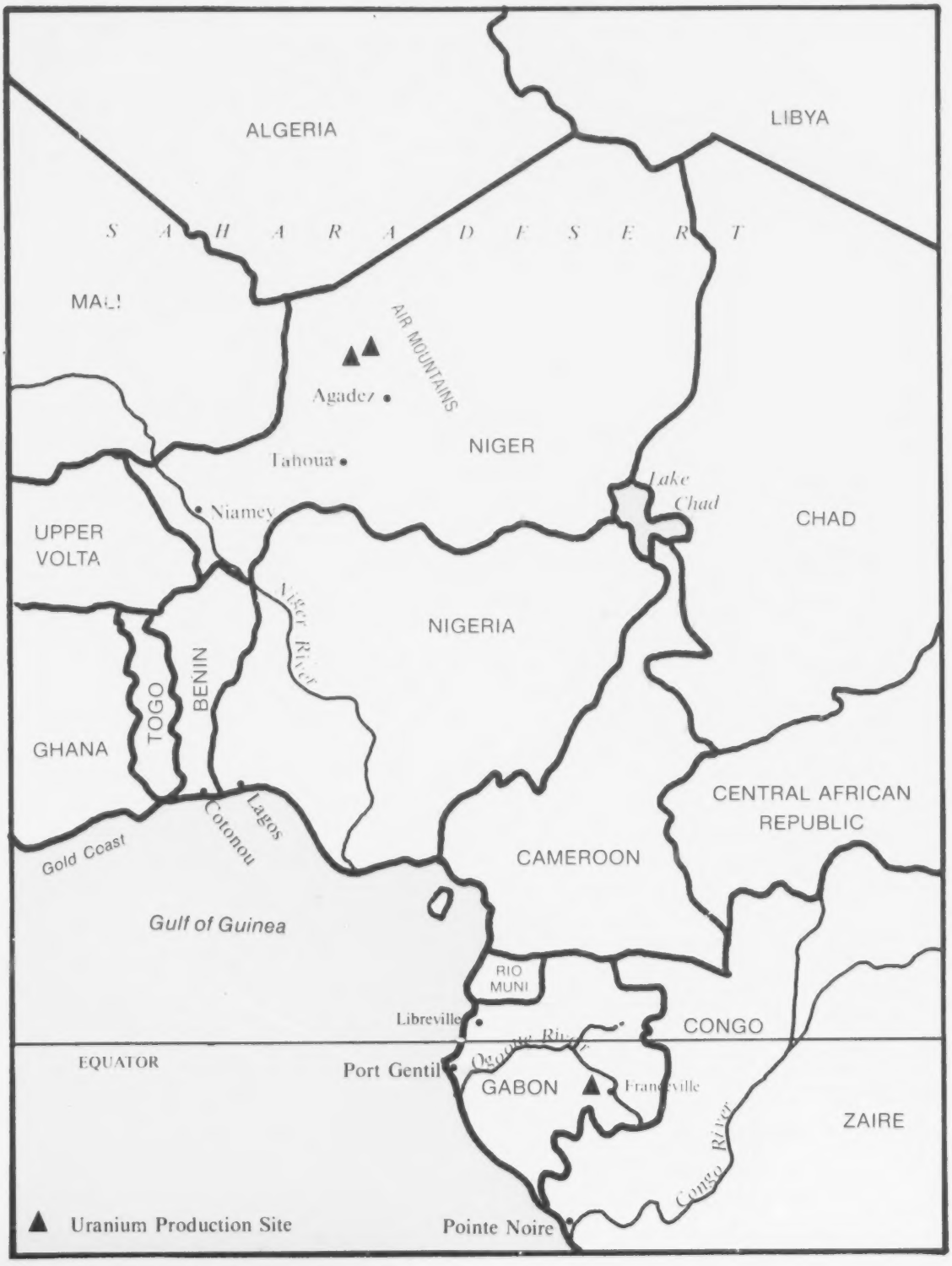
Figure 5
CENTRAL AFRICA



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HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1979
Determined as of the last day of the month indicated

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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	**17.50**						

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	**16.50**						

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	**0.00**						

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GOVERNMENT STATISTICS

AUSTRALIA

	Price index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2R	181.8
Apr 1983	407.3R	180.1R
May 1983	414.7R	180.1
Jun 1983	415.6R	180.2
Jul 1983	408.4R	179.9
Aug 1983	403.1R	179.9
Sep 1983	403.1R	179.8
Oct 1983	397.6R	187.5R
Nov 1983	395.7R	187.5R
Dec 1983	399.3R	187.3R
Jan 1984	399.2R	187.5R
Feb 1984	402.4	187.3R
Mar 1984	403.9	187.1R
Apr 1984	—	194.8

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	Primary Metal Industries Non-ferrous[4] (SIC 298)	Chemicals and Chemical Products[5] (SIC 370-379)
1983 Avg.	298.8	—	14.69	14.30	—	—	11.17
Jun 1983	299.3	17.02	14.60	14.07	11.33	9.84	11.05
Jul 1983	300.4	16.48	14.35	13.93	11.70	9.83	11.04
Aug 1983	301.3	16.93	14.36	13.89	11.82	10.08	11.19
Sep 1983	301.1	17.66	14.90	14.41	11.99	10.32	11.29
Oct 1983	301.6	17.73	15.27	14.65	11.76	10.03	11.30
Nov 1983	301.8	17.82	15.29	14.67	11.78	10.62	11.38
Dec 1983	302.9R	17.84	15.11	14.66	11.86	10.60	11.51
Jan 1984	305.3R	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.5R	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14R	10.84R	11.58
Apr 1984	310.3	—	—	—	—	—	—
May 1984	310.6	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Jul 1983	—	—	262.5	273.7	704,202	314,566
Aug 1983	—	—	265.6	278.9	698,984	311,789
Sep 1983	52.92	117.4	267.3	279.4	696,435	312,264
Oct 1983	—	—	270.0	281.0	693,225	311,418
Nov 1983	—	—	271.4	281.6	688,459	317,485
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	—	—
Apr 1984	—	—	286.1	290.2	—	—
May 1984	—	—	288.3	—	—	—

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.67	13.44	10.58	8.66
Jun 1983	315.3	302.4	298.1	214.55	12.66	13.38	10.52	8.63
Jul 1983	316.5	303.2	299.3	—	12.68	13.56	10.58	8.69
Aug 1983	317.3	304.7	300.3	—	12.63	13.46	10.61	8.64
Sep 1983	317.1	305.3	301.8	216.44	12.71	13.47	10.69	8.75
Oct 1983	318.5	306.0	302.6	—	12.78	13.56	10.78	8.73
Nov 1983	318.3	305.5	303.1	—	12.72	13.56	10.86	8.78
Dec 1983	318.4	306.1	303.5	218.53	12.85	13.34	10.89	8.86
Jan 1984	319.1R	308.0R	305.2	—	12.67R	13.38R	10.91R	8.88R
Feb 1984	320.4	308.8	306.6	—	12.81R	13.34R	10.90R	8.86R
Mar 1984	321.9	311.1	307.3	220.60R	12.85R	13.33R	10.95R	8.88R
Apr 1984	322.5	311.4	308.8	—	12.98P	13.29P	10.97R	8.89R
May 1984	323.3	311.7	309.7	—	—	—	11.02P	8.89P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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